Lean Production Systems and Worker Satisfaction: A Field Study

Khim L. Sim
Western Washington University
Anthony P. Curatola
Avijit Banerjee
Drexel University

The Toyota Production System approaches *leanness* by relying on an important subsystem known as *respect-for-humanity*. In contrast, anecdotal evidence suggests that leanness in the Western world is often an outcome of *lean becomes mean*. In this case study of a manufacturing plant in the United States, results from a structural equation model show that suggestion autonomy, a self-reported measure, is lower than the autonomy initially expected by the management team. Yet, our results illustrate the positive motivational effects of suggestion autonomy tend to have on the workers' well-being, which are manifested in the form of higher perceived employment security, lower effort-reward unfairness, higher job satisfaction, and higher overall satisfaction. Results of the second order effects yielded by the structural equation modeling technique employed support the extant theory that an integrated approach to organizational design is related to worker's overall satisfaction. In other words, the signaling effect of overall satisfaction by the workers can be used to gauge a firm before it moves in the direction of excessive leanness, decreased employee satisfaction and suboptimal system performance.[1]

Introduction

The future of manufacturing in the United States and other advanced industrial countries depends on the ability to achieve dramatic improvements in productivity – output per employee – while continuously improving quality to meet rising customer expectations. In other words, survival in the competitive global economy requires skillful deployment of scarce resources. Proponents of *lean* often regard this as one of the most crucial strategic directions for business firms, in order to achieve world class performance, by doing more with less (Kennedy & Brewer, 2007; Womack, Jones, & Roos, 2003). Even lean critics such as Rinehart, Huxley, and Robertson (1997, p. 2) acknowledge that "If there is one non-debatable proposition in the early literature, it surely must be the claim that lean production will be the standard manufacturing mode of the 21st century." Anecdotal evidence, however, suggests that *leanness* often becomes excessive (Adler, 1995; Bruno & Jordon, 1999; Reinhart, Huxley, & Robertson, 1997) and experts agree that under such circumstances, improvements are not easy to sustain (Schonberger, 2008; Womack, 2007).

Lean production, in attempting to minimize *waste*, embodies an integrated manufacturing system that is intended to maximize capacity utilization and minimize buffer inventories by reducing system variability. As a result, such a system requires workers to assume responsibilities, far beyond what is typically expected in a traditional assembly line or mass production setting. Hence, unless workers are competent, committed, willing and able to take action to solve problems on an ongoing

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basis, the goal of minimizing wasted resources is jeopardized. Therefore, a key element of the Toyota production system in their use of lean manufacturing is the notion of *respect-for-humanity*, whereby workers' suggestions are incorporated into operational decisions and, more importantly, management tangibly communicates its appreciation for the workers' input (de Treville & Antonakis, 2006; Fujimoto, 1999; Kennedy & Brewer, 2007; Womack, Jones, & Roos, 1990; 2003).

The respect-for-humanity concept is viewed as being generally overlooked in western companies. The omission of this concept is likely to be an impediment in the adoption of and realization of the resulting value added by lean in these organizations. To gain an appreciation for these issues, we conducted a field study in a manufacturing plant that had achieved some remarkable operational results and cost savings within the first few years after its implementation of a lean production system. First, we test and examine the underlying reasons for their success by drawing upon the existing organizational theory and motivational literature. Secondly, we provide support to the extant theories that an integrated approach to organizational design is related to the workers' overall satisfaction level, which in turn can be developed as a firm's unique capability of sustainable competitiveness. The ability of a firm to learn about its environment and use this knowledge to guide its action appropriately may give it an edge to outperform its competitors. We find that in a lean manufacturing company, the signaling effect of worker's overall satisfaction can be a gauge to judge whether the firm is heading toward excessive leanness, decreased satisfaction and suboptimal performance.

Literature Review

This section discusses literature relevant to this study including the areas of empowerment and lean practices and related concepts.

Empowerment and Lean Practices

As mentioned before, lean production systems strive to maximize capacity utilization and minimize excess inventories by reducing system variability with the eventual goal of total eradication of waste (de Treville & Antonakis, 2006). Keeping the plant clean and orderly is one practice that is seen to reduce variability, since dirt and disorder often lead to quality problems, which in turn hinder effective problem solving (Hayes, 1981). For example, Toyota requires workers to be committed to their tasks and the company, in order to attain the goals of high utilization and low buffer stocks. These workers are responsible for quality and nonmanufacturing tasks beyond what is typically expected in traditional mass production environments (Fujimoto, 1999). Reduced buffers are only effective if workers are competent, committed, and are allowed to take action immediately when problems arise. Otherwise, workers become alienated and are unwilling or unable to respond to such problems. This appears to contradict the conventional wisdom of the association of high utilization with low inventory.

In Toyota's case, the respect-for-humanity subsystem is structured to incorporate suggestions made by workers, which shows respect and appreciation on the part of the company's management. In summary, the notion of respect-for-humanity aims at "leanness through inventory reduction, increased capacity utilization and variability reduction" (de Treville & Antonakis, 2006, p. 103).

Typically, lean production begins with competitive wages (see, Graham, 1995; Milkman, 1997) and reinforces the workers with the training and equipment needed to perform their job well (Adler, 1995; Womack et al., 1990). Respect for workers also calls for employee empowerment by delegating certain authority and responsibility to the workers. By encouraging the workers to

participate in the development of standard operating procedures, these same workers gain a sense of ownership, which translates into an increased willingness to run the process as formally documented (Adler, 1995; de Treville, Antonakis, & Edelson, 2005; Fujimoto, 1999). One way to increase utilization is to reduce the time allocated to an employee to accomplish a given task. This practice is intended to build upon the philosophy that scarcity results in an environment of creative tension, which tends to motivate workers towards finding creative solutions (Womack et al., 1990). Thus, lean production equips the production floor "well enough to get the job done while leaving resources scarce enough to encourage search behavior" (see, Cyert & March, 1992).[2]

Perceived Organization Support and Lean Practices

Some critics claim that the lack of a supportive and committed organizational environment continues to be an important barrier to the successful implementation of lean practices (see, Bruno & Jordon, 1999; Kumar, 2000). Organizational support theory further addresses the psychological processes underlying the consequences of perceived organization support (POS) (Eisenberger, Cummings, Armeli, & Lynch, 1997). First, POS, on the basis of reciprocity, tends to give rise to a felt obligation to care about the organization's welfare and, therefore, help insure that the organization reaches its objectives. Second, POS should satisfy the socio-emotional needs of the employees by showing care, approval, and respect, so that workers are encouraged to incorporate organizational membership and role status into their social identity. Finally, POS should strengthen employees' beliefs that the organization recognizes and rewards increased performance. These processes provide favorable outcomes for both employees by increasing job satisfaction, as well as heightening positive mood and the organization by reducing turnover, while enhancing employee commitment and performance (Rhoades & Eisenberger, 2002).

Effort-Reward Fairness and Lean Practices

Recent theory and research show that workplace fairness is a contextual factor that inhibits employee's extra work behavior roles. Consequently, the perceived inequity resulting from job effort-reward discrepancy provides an unpleasant emotional state and cognitive dissonance. To diminish this perceived inequity, a worker is likely to alter efforts or withdraw from the job, often resulting in substandard work behavior (Konovsky & Organ, 1996; Niehoff & Moorman, 1993). Both are negative results for the employee, as well as the organization.

In lean manufacturing, effort-spent *vis-a-vis* reward-received is increasingly becoming a major concern for practitioners as a result of work pace intensification, leading to the claim of *lean becomes mean*. Janssen (2000) showed that employees respond more innovatively to higher levels of job demands, when they perceive that their efforts are fairly rewarded by the organization. Understanding the issue of equity, in a setting that demands higher responsibility from the workers advances our understanding of respect-for-workers. Accordingly, the following hypotheses are generated:

H1: Workers' empowerment is negatively related to effort-reward unfairness.
H2: Perceived organizational support is negatively related to effort-reward unfairness.

Job Security and Lean Practices

[2] But, when 'lean becomes mean', the negative consequences have been observed, such as stress, on the job injury, decreased motivation, or quitting. More insight to this issue is provided by de Treville and Antonakis (2006).

Using a large European data set, Ramsay, Scholarios, and Harley (2000) show that job security is positively related to labor productivity, financial performance, and product/service quality, but it is negatively related to turnover. One of the most widely accepted propositions about innovative work practices is that performance improvements are not sustainable over time if employees fear that increased productivity leads to a reduction in jobs (Fiume, 2007; Pfeffer, 1998). Angelis, Conti, Cooper, and Gill (2011) assert that employment stability further strengthens worker commitment; while Womack et al. (1990) show the importance of management support and job security for building a high-commitment lean culture. Accordingly, the following three hypotheses are generated:

H3: Workers' training is positively related to perceived job security
H4: Workers' empowerment is positively related to perceived job security
H5: Perceived organizational support is positively related to perceived job security

Job Satisfaction, Overall Satisfaction and Lean Practices

Research on employee job-satisfaction shows that it is a potential determinant of absenteeism, performance, turnover, and retention. Hackman and Oldham (1980) show that human resource practices are often linked to job satisfaction while Tomer (2001) report that employees who are given greater responsibilities, appear to develop skills and competencies over their job and tend to be more cooperative and creative. Similarly, Witt and Nye (1992) and Brockner and Adsit (1986) show that fairness is an important component of job satisfaction. Other research studies provide evidence that job attitudes, to a large extend, are within the ability of management to influence (Eisenberger, et al., 1997; Griffith, Hom, & Gaertner, 2000). These results support the importance of management's role in nurturing the employee's affective feeling toward the organization. Taking these together, the following four hypotheses are developed:

H6: Effort-reward unfairness is negatively related to job satisfaction
H7: Workers' training is positively related to job satisfaction
H8: Workers' empowerment is positively related to job satisfaction
H9: Perceived organizational support is positively related to job satisfaction

Proponents of job enrichment argue that as more responsibilities and abilities are given to front line workers (hence, the notion of *empowerment*), job commitment and job satisfaction increase (see, Applebaum, Bailey, Berg, & Kalleberg, 2000; Ichniowski, Kochan, Levine, Olson, & Strauss, 1996; MacDuffle, 1995a; 1995b). These authors explore the presence of an effective human resource (HR) *bundle* to enhance the firms' performance. They do not simply argue that the supposed intrinsic motivations are sufficient stimuli to increase workers motivation and discretionary effort. MacDuffle (1995a), for example, argues that motivation is best increased by multiple incentives from integrated and overlapping bundles of HR and manufacturing practices. Likewise, Applebaum et al. (2000) argue that financial rewards and trust are important mechanisms to elicit discretionary effect. While prior research have linked an HR and manufacturing bundle to a firm's performance, little systematic work has been done to link such a bundle to workers' overall satisfaction.

Anecdotal evidence suggests leanness in the Western world is often achieved as a result of lean becomes mean (Adler, 1995; Bruno & Jordan, 1999). Worst still, Reinhart et al. (1997) claim that lean production will always result in excess leanness. In this case, the removal of excessive slack from the system would result in a diminishment of overall satisfaction, which, in turn, affects the workers' overall performance. The implication drawn is that workers' overall satisfaction (i.e., a lead indicator) can be an important indicator in lean implementation. Specifically, it provides a gauge as

to whether a firm is heading toward excessive leanness, thereby leading to decreased satisfaction and suboptimal performance (lagging indicator). Accordingly, our final hypothesis, stated below, examines the integrated effect of HR and manufacturing practices on worker's overall satisfaction.

> H10: The integrated HR and manufacturing practices are positively related to overall satisfaction.

The research model and hypothesized relationships are presented in Figure 1a. The integrated effect of HR and manufacturing practices on worker's overall satisfaction with second order Structural Equation Modeling (SEM) factors is presented in Figure 1b.

Figure 1a: Research Model

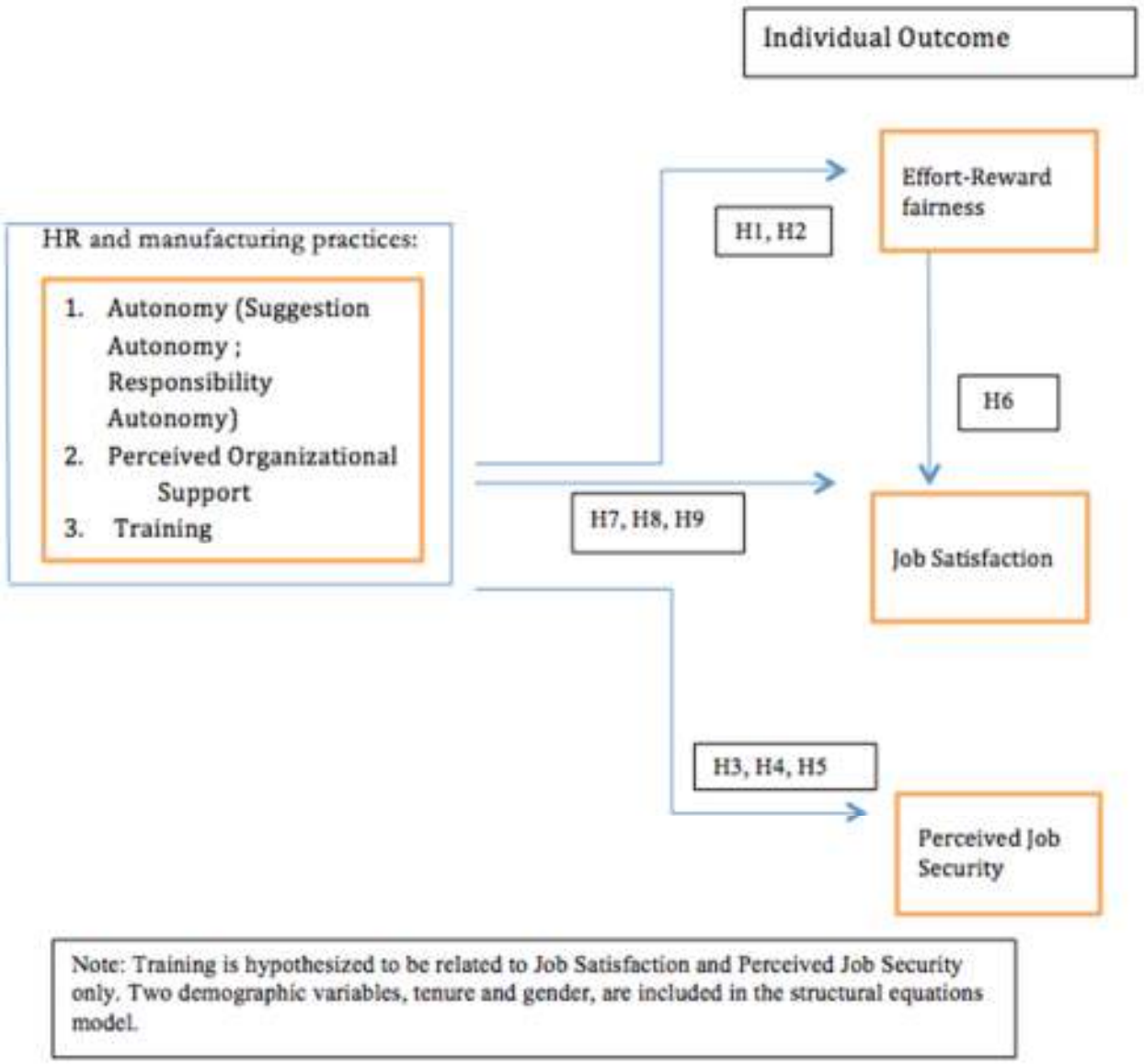
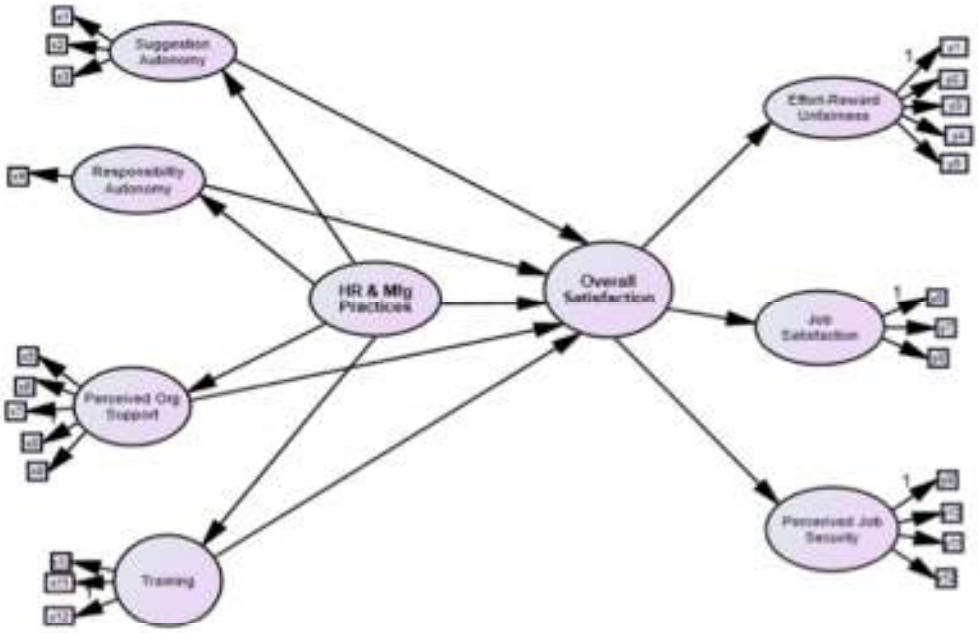


Figure 1b: Integrated Research Model with Second Order SEM Factor



Paths modeled:			Standard Coefficient	CR
Suggestion Autonomy	→	Overall Satisfaction	.830	1.713*
Responsibility Autonomy	→	Overall Satisfaction	.029	0.346
Perceived Organization Support	→	Overall Satisfaction	.365	1.818*
Training	→	Overall Satisfaction	-.205	-.590
Suggestion Autonomy	→	HR& Mfg Practices	.949	4.72***
Responsibility Autonomy	→	HR& Mfg Practices	.208	2.119**
Perceived Organization Support	→	HR& Mfg Practices	.731	4.29***
Training	→	HR& Mfg Practices	.685	4.731***
Effort-Reward Unfairness[&]	→	Overall Satisfaction	-.631	-4.551***
Job Satisfaction	→	Overall Satisfaction	.864	4.758 ***
Perceived Job Security	→	Overall Satisfaction	.718	4.682***
HR& Mfg Practices	→	Overall Satisfaction	.988	4.24***

Model fit: chi Sq = 439, 275 d.f., p<.001; CFI= .87; RMSEA = .069
*significant at .05; **significant at .01 *** significant at ≤ .001

[&] Effort-Reward Fairness was negatively coded. Thus, a higher score represents a higher degree of unfairness. Accordingly, it is expected to be negatively related with Overall Satisfaction.

Methodology

A manufacturing company, located in the Eastern United States agreed to participate in our field study. The company was bought by a major multinational firm a few years prior to the study. The parent company notified the plant's management team that unless they can achieve dramatic improvements in both productivity and quality, the plant would be shut down and relocated to a lower cost region. The closure would result in a loss of over 700 jobs in an area already suffering from the effects of extensive de-industrialization. The possibility of this bleak outcome energized the management team with a mission to save the plant. By May of 2005, they introduced a 100% *Employee Involvement, Continuous Improvement Training* program. Two years later, the entire team received an Achievement Award from the parent company. By the end of 2008, the firm was aiming to become a world class best practices manufacturer. Among the key metrics standing behind this achievement were[3]:

- Customer returns decreased by 84%
- Production cycle time reduced from 21 to 5 days
- Finished goods inventory reduced by $10,000,000
- 33% of production space opened up as a direct result of lower WIP
- Order lead times for custom products reduced by 44%
- Employee grievances reduced by 42%
- Accidents claims down 23.5% - with a $400,000 savings in Workers' Compensation
- Reduction in greenhouse gas emissions and solid waste - with savings rising from $3,000,000 in 2006 to $9,300,000 in 2007.
- Average product cost reduced by 8%

Some of the Lean and Six Sigma Tools utilized by this company included, value stream mapping, visual pull system, standardized work for each process, manufacturing cell layout, problem solving, 5S (workplace organization), and visual control/management. Being a certified six sigma expert, the new plant manager understood that being lean is all about people being engaged. As a result, all employees received at least 12 hours of training in lean concepts and methods.

Survey

The authors visited the manufacturing plant and met with the quality manager, the plant manager and the vice president of manufacturing (hereafter, referred to as our research collaborators). The president of the Union was informed of the proposed study and provided his total support.

A random sample of 35 percent of the production employees received the survey instrument. Our research collaborators from the company distributed the questionnaires, as evenly as possible, to the unionized hourly workers across the three shifts, spanning across multiple production departments. The workers completed the survey in the company's meeting room and returned it on the same day. The data collection process stretched across a three week period. A total of 135 useable surveys of the 151 surveys distributed were received. Sixteen surveys were dropped from the study due to incompleteness or failing to pass a validity check.

[3] Proprietary information shared by the research collaborators.

Constructs Measures

The effort-reward fairness construct was measured using a 7-point Likert scale (1= Totally Disagree, 7= Totally Agree). All other constructs were measured using a 5-point Likert scale (1= Strongly Disagree, 5= Strongly Agree). Appendix A provides detailed information related to the questionnaires.

Lean Practices. Four questions assessed the climate of how receptive the employees are regarding the 'quest for continuous improvement'. They include: The company is working hard (1) toward the goal of total customer satisfaction, (2) to eliminate waste in the processes, (3) to meet and exceed expectations in product quality, and (4) to reduce product cost. These questions are taken from Womack et al. (1990).

Effort-Reward fairness. Perceived effort-reward fairness, adapted from Van Yperen (1996), consists of a 6-item scale, which has high internal consistency. As a result, they are used in numerous scholarly research papers (see, Janssen, 2000; 2001; Van Yperen, 1996; 1998). All of these 6-item are reverse coded, indicating that a high score represents a high level of effort-reward unfairness.

Job Satisfaction. Job satisfaction as a result of the work philosophy change is determined from a three item scale, adapted from Hackman and Oldham (1975), who reported an internal consistency reliability of 0.76.

Perceived Job Security. A three item scale adapted from Sim and Roger (2009) measure the perceived job security construct. Since lean practices are relatively new in this plant, a fourth item was included to provide relevant information to management about the overall success of the system, from the employees' point of view. Specifically, the fourth item is: "Overall, my future in this company appears to be more promising compared to 2 to 3 years ago".

Perceived Organizational Support. Perceived organizational support (POS) is assessed by using the scale developed by Eisenberger et al. (1997). One item, "If given the opportunity, the company would take advantage of me" was excluded because we felt that this statement is too negative.

Training. Management recognized training as one of the critical elements to the successful implementation of lean. Hence, we measured training by using a four item scale from Sim and Rogers (2009). Since this scale is relatively new, it was tested in another pilot study where 83 production employees completed the questionnaire. Cronbach's alpha for the 4 items in the pilot study was 0.72.

Empowerment/ Autonomy. To measure the extent of empowerment or autonomy on the part of the production employees, we selected the 4-item empowerment scale from Powell (1995). These items measure production employees' involvement, the importance given to their suggestions and their decision making autonomy. One item, however, is modified by replacing it (which reads "A more active employee suggestion system") with two items. The newly added items are "The company does not value my idea/suggestions relative to continuous improvement" and "The company allows me through programs or forums to express my ideas and opinion about continuous improvement". These two items have been tested in a pilot study using 83 plant workers. As a result, these five items are used to measure the construct of empowerment/autonomy.

Results

The results are presented in two parts. The first part presents the descriptive statistics based on the demographic information pertaining to the participants. The second part presents the results of the statistical analyses based on the participant's responses.

Descriptive Statistics

The general demographics for the participants are fairly typical of a small plant. Thirty-four percent of the respondents have spent 5 years or less with the company and approximately 41 percent of the respondents have 11 or more years of employment. The majority of the respondents (78%) have high school diplomas, one has a master's degree, and the remaining employees have either an associate's or a bachelor's degree. Seventy nine percent of the respondents are male and 21 percent are female. Finally, the plant operates three shifts per day with 43%, 23%, and 32% of the employees assigned to shifts 1, 2 and 3, respectively.

Statistical Analysis

The data analysis begins with a latent variable SEM (Structural Equation Modeling) technique to test the hypothesized linkages of the research model. The SEM technique tests the linkages in the structural model, taking into account measurement errors. The measurement model begins with a confirmatory factor analysis (hereafter referred to as CFA). The CFA assesses whether all items in a given scale represent the same latent factor. Typically, a value greater than 0.9 for the comparative fit index (CFI) and a value of less than 0.10 for the standardized root mean square residual (RMSEA) are considered a good fit (Bagozzi, Yi, & Phillips, 1991; Bentler, 1990; Kline, 2005).

Results from principal component analyses are used in performing the CFA. Table 1 reports the standardized loading, reliability and variance extracted from the CFA. Lean practices, job security, reward-effort fairness and training loaded cleanly onto themselves as a factor.[4] The first 2 items of POS did not load onto themselves; as a result, (POS) became a 5-item construct. With respect to the job satisfaction factor, one item (Sat3) is dropped because of low loading in the principal component analysis, while (S2) from POS loaded onto job satisfaction. Similarly, because of a low loading in principal component analysis, one item from empowerment is deleted. The remaining four items loaded onto two factors, i.e., suggestion autonomy and responsibility autonomy. In summary, all items loaded onto the original factors with the exception of one item from POS that loaded onto job satisfaction. The Cronbach's alpha ranges from a high of 0.87 to a low of 0.61. The variance extracted in most cases were good or moderate, with the exception of job satisfaction, job security and suggestion autonomy, which have values of 0.46, 0.43, and 0.35, respectively.

The correlation matrix, along with its means and standard deviations are presented in Table 2. Most of the constructs are positively correlated at the one percent level of significance. This correlation results are not surprising since they represent the overlapping practices in a lean production system. Also, these correlations are well below the suggested cutoff point of .90 (Bagozzi et al., 1991). As a validity measure, the *Continuous Improvement Effort* in lean practices has a mean score of 4.3 (out of 5) suggesting that, on average, the respondents agree that the company has kept up with the practice of continuous improvement. The mean score for both Job Satisfaction (3.63 out of 5) and Training (3.61 out of 5) are relatively high and responsibility autonomy has the highest

[4] One item each from training (loading of .44) and effort-reward fairness (loading of .48) were excluded in CFA due to low loading.

Table 1: Standardized Loading, Reliability and Variance Extracted from the CFA

Construct and indicators	Standardized Loading	Reliability	Variance Extracted
Effort-Reward Unfairness		.87	.56
E1	.655		
E2	.783		
E3	.785		
E4	.807		
E5	.691		
Job Satisfaction		.71	.46
Sat1	.665		
Sat2	.597		
S2	.774		
Job Security		.78	.43
J1	.673		
J2	.596		
J3	.755		
J4	.626		
Perceived Organizational Support		.80	.60
S3	.410		
S4	.675		
S5	.847		
S6	.856		
S7	.580		
Training		.79	.58
T1	.669		
T2	.803		
T3	.805		
Suggestion Autonomy		.61	.36
A1	.506		
A2	.537		
A3	.734		
Responsibility Autonomy		n/a	n/a
Lean Practices			
L1	.72	.79	.48
L2	.77		
L3	.71		
L4	.56		

Note: Please refer to Appendix A for the itemized description. For Lean Practices, If L4 is deleted; Lean Practices will have variance extracted of 0.54. Also note that Lean Practices is captured as a validity measure, it is not used in the research model.

Table 2: Construct Means and Correlations

	Mean (S.D)	X1	X2	X3	X4	X5	X6	X7	X8	X9
X1 Tenure	N/A									
X2 Gender	N/A	.107								
X3 POS	2.99 (.98)	.103	-.060							
X4 Training	3.61 (.90)	-.078	.103	.370**						
X5 Suggestion Autonomy	2.95 (.95)	.054	.032	.630**	.812**					
X6 Responsibility Autonomy	4.22 (.97)	.097	-.081	.121	.228*	.201*				
X7 Job Security	2.94 (.98)	.147	.230*	.561**	.448**	.715**	.02			
X8 Eff. Reward Unfairness	4.2 (1.53)	.115	-.07	-.507**	-.367**	-.533**	-.139	-.429**		
X9 Job Satisfaction	3.63 (.95)	.010	.137	.657**	.597**	.762**	.196*	.569**	-.643**	
X10 Continuous Improvement Effort	4.33 (.70)	.075	.208*	.408**	.414**	.402**	.111	.391**	-.381***	.621**

N = 135; * significant at 5%; ** significant at 1%;

Table 3: Results of the Hypotheses Testing

Hypothesis	From	To	Standardized Coefficient	Hypothesis Supported?	
H1a	Suggestion Autonomy	Effort -Reward Unfairness	-.256	-1.919***	Yes
H1b	Responsibility Autonomy	Effort-Reward Unfairness	-.072	--0.874	No
H2	Perceived Organizational Support	Effort-Reward Unfairness	-.388	-2.888**	Yes
H3	Training	Job Security	-.281	-.902	No
H4a	Suggestion Autonomy	Job Security	.791	1.875*	Yes
H4b	Responsibility Autonomy	Job Security	-.084	-.924	No
H5	Perceived Organizational Support	Job Security	.213	1.155	No
H6	Effort-Reward Unfairness	Job Satisfaction	-.302	-2.628***	Yes
H7	Training	Job Satisfaction	.152	.712	No
H8a	Suggestion Autonomy (indirect)	Job Satisfaction	.086	1.028#	Yes
H8b	Responsibility Autonomy	Job Satisfaction	.027	.341	No
H9[5]	Organizational Support (direct)	Job Satisfaction	.268	1.819*	Yes
	Organizational Support (indirect)	Job Satisfaction	.243	2.15**	Yes
H10	HR & Manufacturing Practices	Overall Satisfaction	.988	4.242***	Yes

[5] Total effect with standardized coefficient of .385 is significant at *pv* = 0.015. Since both direct and indirect effects are statistically significant, both results are reported.

significant at .10; *significant at .05; ** significant at .01; *** significant at ≤ .001

out of 5) and Training (3.61 out of 5) are relatively high and responsibility autonomy has the highest mean score of 4.22 out of 5. In contrast, suggestion autonomy has a relatively low mean score of 2.95 out of 5. These results suggest that although a high level of responsibility has been delegated to the production workers, they do not feel (given the low suggestion autonomy) that their input, suggestions, or voices are valued sufficiently, in most part.

Perceived job security with a mean score of 2.94 out of 5, suggests that, on average, the respondents are not very optimistic about their job security. This result is consistent with a company recently acquired and potentially facing closure or relocation. Finally, the mean score for effort-reward fairness is 4.20 (out of 7, with 4 being neutral). Since a higher score represents a higher level of perceived inequity or unfairness, these results imply that the workload may have increased in comparison to wages received. The managerial implications of these results are more fully discussed in the concluding section of the paper.

Table 3 provides the results of the hypotheses tests, obtained via the structural equation model. Seven out of the thirteen hypotheses were supported. Two control variables, tenure and gender, were included in the structural equation model (SEM). Tables 4A through 4E provide the detailed results of individual regression analyses within the SEM.

Table 4A shows that perceived organizational support (p = 0.002) and having more autonomy (p = 0.003) are positively related to the perception of effort-reward fairness. In addition, production employees with longer tenure report a higher level of perceived effort-reward unfairness than those employees who are newer to this company (p = 0.016). All three variables have an indirect effect on job satisfaction via effort-reward fairness.

Table 4B shows that the length of employment is negatively related (indirect effect) to job satisfaction (p = 0.029) while both perceived organization support (p = 0.019) and suggestion autonomy (p = 0.07) are positively related to job satisfaction via effort-reward fairness. In addition, both effort-reward fairness (p =0.005) and perceived organizational support (p = 0.035) have a direct effect on job satisfaction. Finally, Table 4C shows that female production employees (p = 0.013) have a higher perceived job security than their male counterparts; while suggestion autonomy (p = 0.03) is positively related to perceived job security.

Table 4D shows that the HR & manufacturing practices are positively related to overall satisfaction (p = 0.001) and that female production workers (p = 0.036) show a higher overall satisfaction level.[6] To test the consistency of the SEM results, Table 4E gives a breakdown of the individual HR & manufacturing practices on overall satisfaction. The perceived organizational support, suggestion autonomy and gender are all statistically significant. In addition, the statistical significance for the HR & manufacturing practices (or, the HR and Manufacturing *bundle*) has a p value of 0.001, which is lower (i.e., of greater significance) than that of perceived organizational support (p =0.035) and suggestion autonomy (p =0.044). These results provide support for the bundle effect of the HR & manufacturing practices on overall satisfaction.

[6] By and large, female production workers may not be the sole breadwinner in a family and workers are paid better in a lean manufacturing than in a non-lean setting (see, Graham, 1995; Milkman, 1997). Thus, these inherent factors may have filtered through the findings of this study.

Table 4A: Effort-Reward Unfairness, Individual Regression Within the SEM

Predictor	Predicted Sign	Coeff	S.E.	C.R.	P
Perceived Organizational Support	(-)	-.802	.278	-2.888	.002**
Suggestion Autonomy	(-)	-.600	.313	-1.919	.003*
Responsibility Autonomy	(-)	-.111	.127	-.874	.382
Tenure	?	.211	.088	2.402	.016*
Gender	?	-.460	.303	-1.516	.130

Table 4B: Job Satisfaction, Individual Regression Within the SEM

Predictor	Predicted Sign	Coeff	S.E.	C.R.	P
Effort Reward Unfairness	(-)	-.160	.061	-2.628	.005**
Perceived Organizational Support[a]	(+)	.294	.161	1.819	.035*
Training	(+)	.134	.188	.712	.477
Suggestion Autonomy[b]	(+)	.350	.341	1.028	.304
Responsibility Autonomy	(+)	.022	.064	.344	.731
Tenure[c]	?	.048	.048	1.010	.312
Gender	?	.189	.157	1.204	.229

[a] The coefficient of indirect effect via Effort Reward Unfairness is .128 (p=0.019*)
[b] The coefficient of indirect effect via Effort Reward Unfairness is .096 (p=0.07#)
[c] The coefficient of indirect effect via Effort Reward Unfairness is .-034 (p=0.029*)

Table 4C: Perceived Job Security, Individual Regression Within the SEM

Predictor	Predicted Sign	Coeff	S.E.	C.R.	P
Perceived Organizational Support	(+)	.290	.251	1.155	.248
Training	(+)	-.308	.342	-.902	.367
Suggestion Autonomy	(+)	1.218	.650	1.875	.030*
Responsibility Autonomy	(+)	-.086	.093	-.924	.356
Tenure	?	.018	.067	.264	.792
Gender	?	.562	.225	2.493	.013*

significant at .10; *significant at .05; ** significant at .01; *** significant at ≤ .001

Table 4D: Overall Satisfaction, Individual Regression Within the SEM

Predictor	Predicted Sign	Coeff	S.E.	C.R.	P
HR & Mfg Practices	+	1.085	.256	4.245	.001***
Tenure	?	.000	.035	-.004	.997
Gender	?	.269	.128	2.097	.036*

significant at .10; *significant at .05; ** significant at .01; *** significant at ≤ .001

Table 4E: Overall Satisfaction, Individual Regression Within the SEM

	Predicted				
Predictor	**Sign**	**Coeff**	**S.E.**	**C.R.**	**P**
Perceived Organizational Support	(+)	.352	.193	1.818	.035*
Training	(+)	-.158	.272	-.590	.562
Suggestion Autonomy	(+)	.903	.527	1.713	.044*
Responsibility Autonomy	(+)	.021	.061	.351	.730
Tenure	?	-.033	.046	-.714	.475
Gender	?	.372	.153	2.433	.015*

significant at .10; *significant at .05; ** significant at .01; *** significant at ≤ .001

Finally, a parsimonious SEM is generated by deleting the two practices (i.e., training and responsibility autonomy), which are not statistically significant in the model. The overall fit measures for the parsimonious SEM declines significantly. As seen in Table 5, GFI declines to 0.74, AGFI declined to 0.67, TLI declined to 0.71, and RMSEA decreases to 0.10. These results suggest, although training and responsibility autonomy are not statistically significant individually; collectively, the four practices (i.e., perceived organizational support, suggestion autonomy, responsibility autonomy and training) affect worker's overall satisfaction. In summary, a consistent pattern appears to emerge from the SEM. In addition, the various analyses performed tend to reinforce one another. For example, the RMSEA is 0.06 and the CFI is 0.90, which indicate a good fit. Other values, such as GFI, AGFI and TLI are slightly lower, but still indicate a good fit.

Table 5: Measures of fit for the structural model

Fit measure	Recommended Value	CFA	Second Order SEM - CFA	Structural Model, Fig 1a	Structural Model, Fig 1b	Parsimonious[a] Model
GFI	> 0.90	0.81	0.82	0.82	0.80	0.74
AGFI	>0.85	0.75	0.77	0.76	0.76	0.67
CFI	> 0.95	0.89	0.90	0.88	0.87	0.75
TLI	> 0.95	0.87	0.89	0.86	0.85	0.71
RMSEA	< 0.1	0.06	0.06	0.066	0.069	0.10

[a] The Parsimonious model (i.e., deleting two variables, training and responsibility autonomy, which are not statistically significant) did not provide good fit measures. This result is consistent with the integrated model of keeping all exogenous variables. Hence, detailed results for the parsimonious model were not reported.

Discussion and Conclusion

To gain a better understanding of the effects of organizational design on perceived job security, effort-reward fairness, job satisfaction and ultimately overall satisfaction in lean manufacturing systems, a field study is conducted on a company that recently changed to lean

production. Our results provide suggestions on how managers can rely on strategically linked performance measures as an effective competitive tool. Specifically, our structural equation modeling procedure provide support for suggestion autonomy in all three of the postulated hypotheses, while it provided support for perceived organizational support in only two of the three hypotheses. On the other hand, the hypothesized relationships are not supported for responsibility autonomy and training. Nevertheless, the collective practices, or the HR and manufacturing 'bundle', are positively related to overall satisfaction. These results have some important implications.

Vidal (2007, p. 248) wrote, "The increase in the responsibilities and abilities of front-line workers – labeled empowerment by many academics, business gurus and practitioners is argued to increase job satisfaction." On the other hand, Sim and Carey (2003, p. 112) define empowerment as " … a means of giving the authority to make decisions to that level or people in the organization, which by virtue of available knowledge and closeness to the activity concerned, is most able to make a correct, quick, and effective decision." Accordingly, most academic research treats empowerment as a single construct (see, Anderson-Connolly, Grunberg, Greenberg, & Moore, 2002; Kennedy & Brewer, 2007). In contrast, de Treville and Antonakis (2006, p. 110) treated empowerment in lean production as two distinct constructs: (a) choice (or freedom) concerning procedures, and (b) an increase in accountability arising from decentralization of authority, power sharing, and participation in decision making. Our confirmatory factor analysis for the empowerment construct is consistent with de Treville and Antonakis (2006) by our finding of two dimensions of empowerment; a higher 'responsibility autonomy' (mean score of 4.22 out of 5) and a lower 'suggestion autonomy' (mean score of 2.95 out of 5).

Parker, Wall, and Cordery (2001) and Hackman and Oldham (1980), in their job characteristics model, suggest that both responsibility autonomy and suggestion autonomy should invoke intrinsic motivation leading to favorable outcomes such as job satisfaction or lower absenteeism and turnover. Our results, find evidence that suggestion autonomy affects effort-reward fairness, which in turn affects job satisfaction indirectly. In addition, suggestion autonomy affects perceived job security, but we do not find support for responsibility autonomy from the SEM. Vidal (2007) suggests that employee involvement programs may result in substantial new responsibilities, which can create pressures and psychological tensions that are experienced as burdens rather than motivational challenges. Presumably, high utilization (by limiting resources to workers) in lean practices provides challenging goals which can elicit 'search behavior' and is intended to expose workers to opportunities for utilizing, not only their motoric, but also their cognitive skills (see, Cyert & March, 1992). Nevertheless, work becomes stressful and any positive effects of 'limiting resources' tend to decline in magnitude and in some cases, may even become negative, if the process becomes excessively lean. Hence, the above literature provides plausible explanations on the lack of evidence of motivational effect of responsibility autonomy in this study.

Although the motivational effect of empowerment has been well documented in prior literature, in our field study, we found that suggestion autonomy, a self-reported measure from the production employees, is lower than that expected by the management team. Yet, the responses illustrate the positive motivational effects of suggestion autonomy on workers' well-being, manifested in the form of higher perceived employment security, effort-reward fairness, job satisfaction, and overall satisfaction. Thus, our results suggest that companies that embrace 'true' empowerment of workers, among others, can often reap the many advantages of lean practices. The counter-claim, made by some that, rather than empowering the workers, the new work systems leads to a loss of control and autonomy, while placing a wide range of increased demands on workers needs further examinations.

Lean production's emphasis on respect for worker is consistent with worker's perception of justice and how equity is distributed in the workplace. Bruno and Jordon (1999), for example, show

that deterioration in lean implementation occurs mainly due to unequal power sharing and management mistrust in their study of a Mitsubishi plant in Illinois. Our findings show that a higher level of perceived organizational support is associated with a higher effort-reward fairness, which in turn affects job satisfaction directly and indirectly. Consequently, when management nurtures the employees, they provide the support, which enhances the employees' feeling of less effort-reward unfairness, leading to higher job satisfaction. This research joins others in supporting the notion that perceived support affects job satisfaction (Eisenberger et al., 1997). With respect to effort-reward fairness, Janssen (2000) has argued that if efforts are not fairly rewarded, the motivational effect may not be realized. Hence, to the extent that both suggestion autonomy and perceived organizational support are associated with higher perceived effort-reward fairness, management can elicit positive worker behavior by increasing both the intrinsic and extrinsic rewards by providing support, autonomy, as well as an appropriate balance between 'limiting resources' and eliciting 'cognitive' skill. Our findings further support the position that a manufacturing system that aims to maximizing capacity utilization and minimizing buffer inventories by reducing variability, can achieve these goals by emphasizing the notion of respect for workers. This emphasis is achieved by providing support, empowerment and fairness in effort-reward. These findings are consistent with those of earlier studies, suggesting that organizations which alienate workers through their practices will be less effective and efficient since satisfied employees tend to work harder and better than frustrated ones (Gross & Etzioni, 1985; Ostroff, 1992).

Strategic management accounting has long suggested that the best performance measures are those linked to a business' strategy. Moreover, an integrated system of scorecards should incorporate a complex set of cause-and-effect relationships among the capabilities or critical variables (see, Atkinson & Epstein, 2000; Kaplan & Norton, 2008). Although lean accounting has been used in manufacturing companies for some time, there is still a lack of systematic accounting research linking strategic performance measures with lean practices. Results from the SEM employed here support the existing theory that an integrated approach to organizational design is related to workers' overall satisfaction, which in turn can be developed as a firm's unique capability of sustainable competitiveness. Although causal effects of overall satisfaction on a company's performance cannot be asserted from this field study, there are numerous research studies[7] linking satisfaction with performance. This particular company achieved improvement in their operations and experienced significant cost savings in a few years after switching to a lean production environment.

One final issue pertains to detecting the juncture when lean becomes excessively so, with detrimental effects. Managers need to monitor worker's overall satisfaction along with other strategically linked capabilities. Thus, the signaling effect of 'worker's overall satisfaction' is one gauge the firm can use to sense whether the firm is heading toward excessive leanness, decreased satisfaction and, ultimately, suboptimal performance.

Limitations

Several limitations exist in this study. The data is limited to a single manufacturing plant. Just as with any case study, one cannot simply generalize the results obtained here to other companies. This research, nonetheless, does provide some insights into the possible effects of switching to lean production in the face of increased competition, or when confronting the stark choice between innovative adaptation or plant relocation, leading to loss of jobs.

Furthermore, we found that responsibility autonomy becomes a single item construct as a result of CFA loading. Although results on suggestion autonomy are statistically significant, a more

[7] See, Bhagat, 1982; Organ, 1977.

comprehensive measure of empowerment is desirable for meaningful future research. Finally, it will be beneficial to interview a few production employees to further validate some findings of this work. Unfortunately, two of our collaborators accepted positions in another manufacturing plant and, as a result, we could not contact them to conduct interviews as planned. Management, however, concurred with many of our findings. Despite the above mentioned limitations, we believe that this study provides additional clarity on factors that impede or enhance the lean implementation and deployment of lean production systems.

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Khim L. Sim is an associate professor of accounting at Western Washington University. She has published in international and regional journals, including *Journal of Management Accounting Research, Advances in Management Accounting, International Journal of Operations and Production Management,* and *International Journal of Services and Operations Management,* among others.

Anthony P. Curatola is the Joseph F. Ford Professor of Accounting & Tax at Drexel University, Pennsylvania. Tony is currently the editor of the tax column in *Strategic Finance.* He can be reached at curatola@drexel.edu.

Avijit Banerjee is a professor of decision sciences at Drexel University. He has published widely, including in *European Journal of Operation Research, OMEGA, International Journal of Production Economics,* and *International Journal of Production Research*, among others. His expertise includes supply chain management, interface with marketing, and revenue pricing management.

Appendix A: HR & Manufacturing Practices and Satisfaction Scale

Please indicate the extent to which you agree or disagree with the following statements (1= Totally Disagree; 3=Neutral; 5=Totally Agree)	
Suggestion Autonomy (A1-A3); Source: Powell (1995)	The company encourages employees to involve in design, planning, and problems solving. The company does not value my ideas/suggestions relative to Continuous Improvement (Reversed Coding).
Responsibility Autonomy Source: Powell (1995)	The company allows me through programs or forums to express my ideas and opinion about continuous improvement. I am able to act independently of my supervisor in performing my job function.
Perceived organizational Support (S1-S7) Source: Eisenberger et al. (1997)	Over the years, interactions between employees with customers and suppliers have increased (Dropped). Help is available from the company when I have a problem (Dropped). The company is willing to extend itself in order to help me perform my job to the best of my ability (loaded unto Job Satisfaction). Even if I did the best job possible, the company would fail to notice (Reversed Coding) The company takes pride in my accomplishments at work. The company really cares about my well-being. The company cares about my general satisfaction at work. The company show very little concern for me (Reversed Coding).
Training (T1-T4) Source: Sim and Roger (2009)	My knowledge of continuous improvement allows me to apply them at work. The company provides me adequate training to be productive during improvement events. Continuous Improvement training is provided in a clear concise manner with many practical examples on how to best use the tools. People leading improvement initiatives have the proper amount of training to effectively produce desired results (Dropped).
Lean Practices (L1-L4)[8] Source: Womack et al. (1990)	The company is working hard toward the goal of total customer satisfaction. The company is working hard to eliminate waste in processes. The company is working hard to meet and exceed expectation in product quality. The company is working hard to reduce product cost.
Individual Outcome (Satisfaction): Indicate the extent to which you agree or disagree with the following statements (1= Totally Disagree; 3=Neutral; 5=Totally Agree)	
Effort-Reward Fairness[9] (E1-E6) Source: Van Ypreren (1996)	I work too hard considering my outcome. I give a great deal of time and attention to the organization, but do not feel appreciated. I invest more in my job than I receive in return. The rewards I receive are not proportional to my investments.

[8] Continuous Improvement Effort was measured but it was not used in the structural model. Instead it is used as a validity measure.

[9] This is the only construct which has a scale of 1-7 (1=Totally Disagree; 4=Neutral; 7=Totally Agree)

	I put more energy into my job than it is worth. I feel unfairly treated in my job (Dropped).
Perceived Job Security (J1-J4) Source: Sim and Roger (2009)	Continuous improvement initiatives have increased our job security. Utilizing continuous improvement tools, the company will focus on keeping local jobs. The company will try its best to reduce and/or eliminate layoffs. Overall, my future in this company appears to be more promising compared to 2-3 years ago.
Job Satisfaction (Sat1-Sat3) Source: Hackman and Oldham (1975)	Generally speaking, I am very satisfied with this job. I frequently think of quitting this job (Reversed Coding). I am generally satisfied with the kind of work I do in this job (Dropped).